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(54) **AIRCRAFT FUEL TANK VENT PROTECTOR**

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F16K 17/00	(2006.01)
F16K 17/40	(2006.01)
B64D 37/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F16K 17/00*** (2013.01); ***B64D 37/005*** (2013.01); ***F16K 17/403*** (2013.01); *Y10T 137/1714* (2015.04); *Y10T 137/3003* (2015.04)

(58) **Field of Classification Search**

CPC F16K 17/14; F16K 17/403; F16K 13/04
USPC 137/68.11, 68.13, 68.19, 68.21, 68.27, 137/68.28, 68.29; 220/89.2; 138/39, 40, 89
See application file for complete search history.

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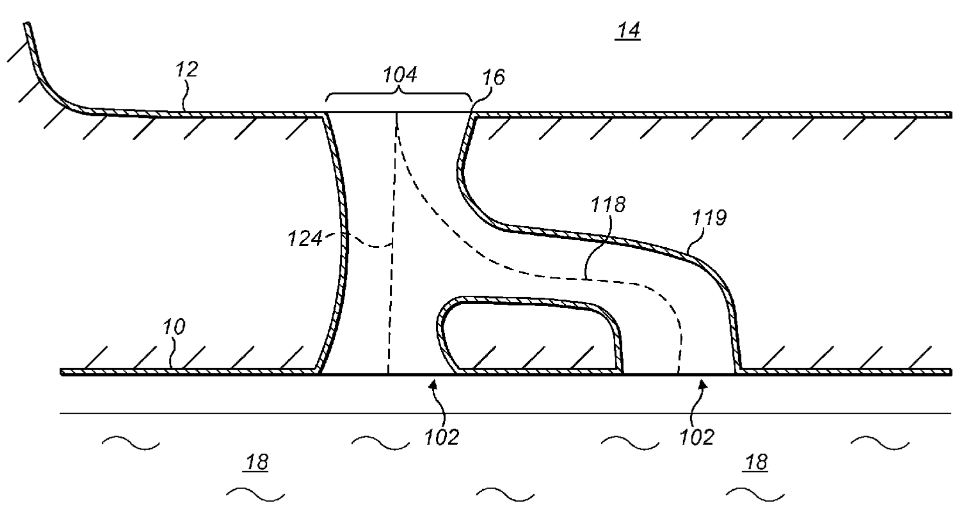
(57) **ABSTRACT**

An aircraft fuel tank vent (**100**, **200**, **300**) having a first interface (**102**, **202**, **302**) for fluid communication with an aircraft fuel tank interior, and a second interface (**104**, **204**, **304**) for fluid communication with an aircraft fuel tank exterior, the vent comprising: a first flow path (**118**, **218**, **326**) between the first interface and the second interface, the fuel tank vent having a baffle (**126**, **226**, **317**) positioned in the first flow path, and, a second flow path (**124**, **224**, **326**) between the first interface and the second interface, the fuel tank vent having a overpressure device (**120**, **220**, **322**) positioned in the second flow path, wherein the first and second flow paths are common along at least a part of their length such that they are coincident at the second interface.

12 Claims, 5 Drawing Sheets



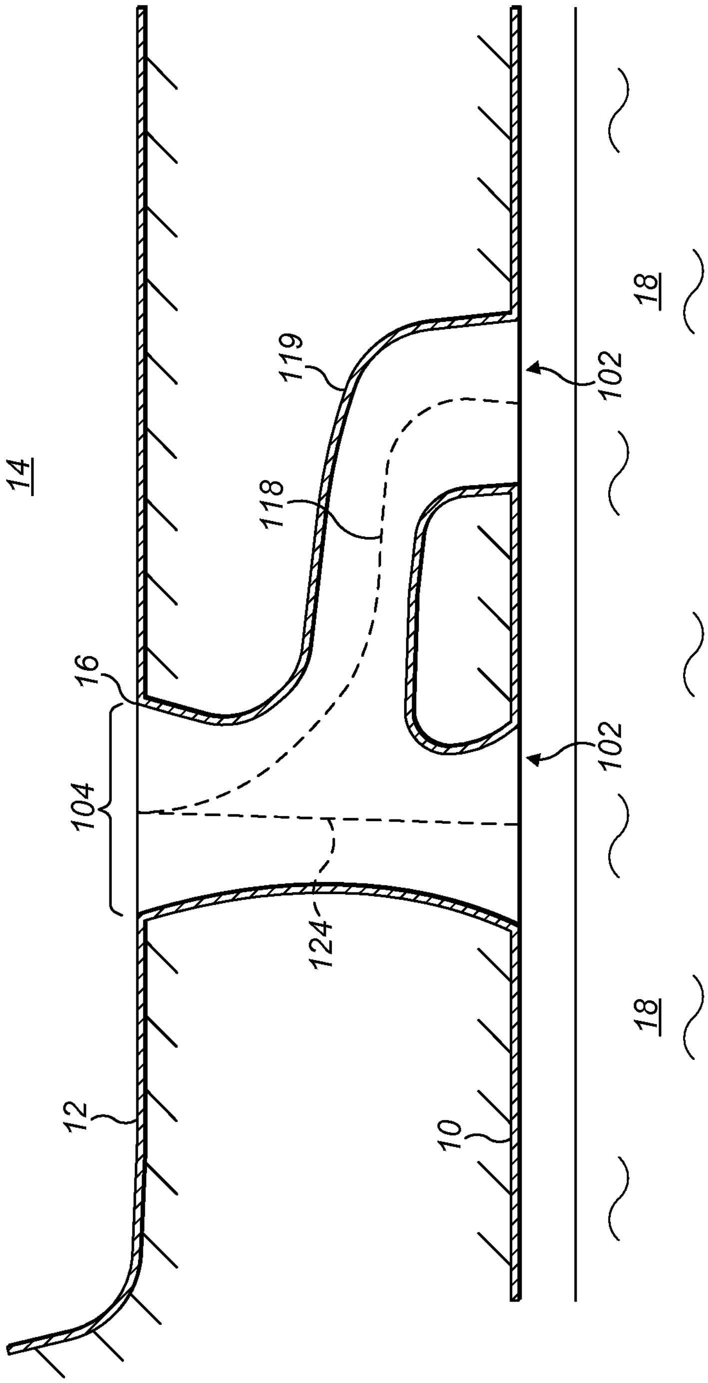


FIG. 1a

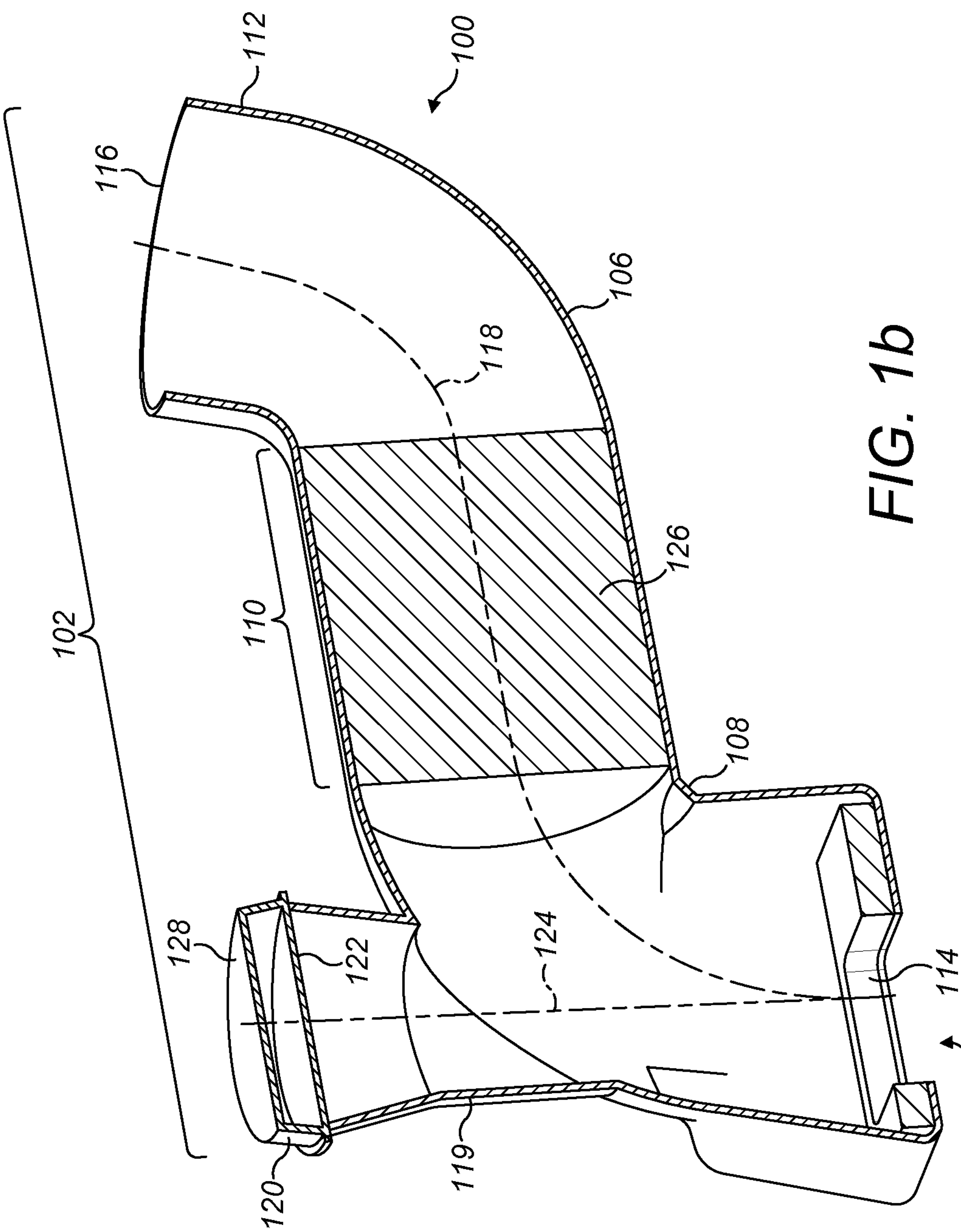


FIG. 1b

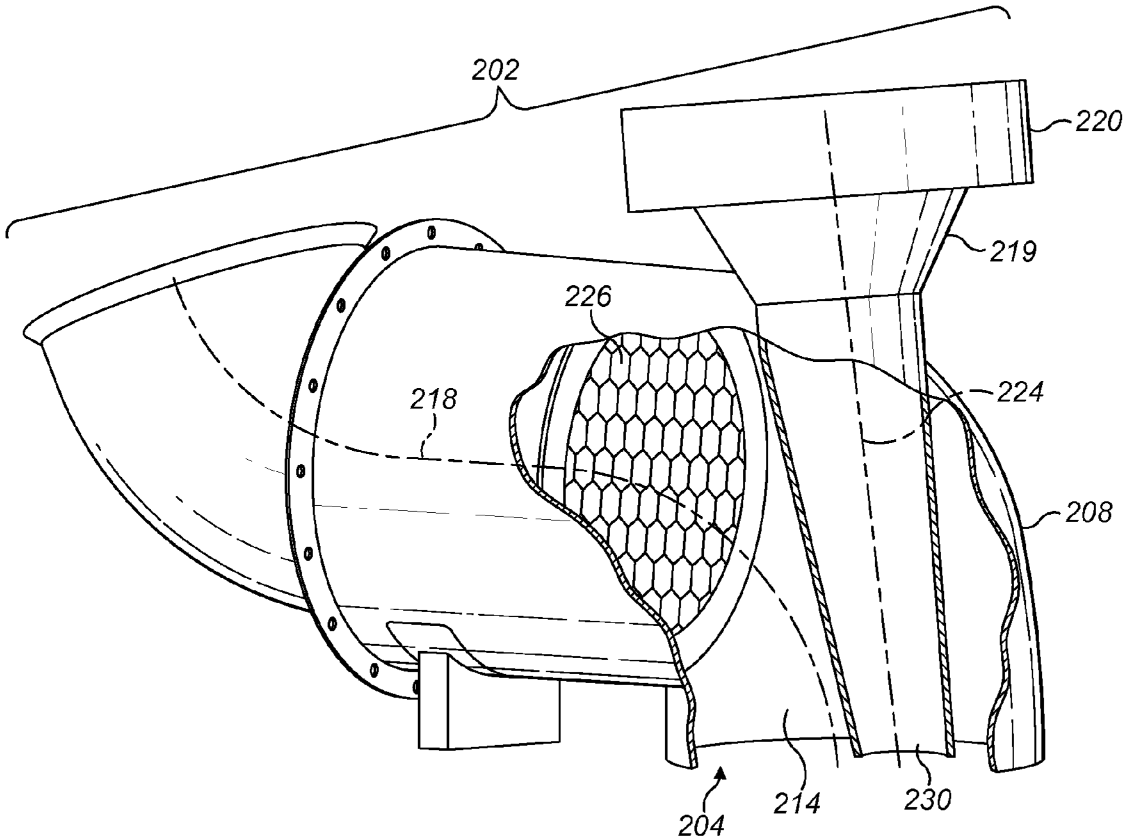

202
220
219
226
218
224
208
204
214
230

FIG. 2a

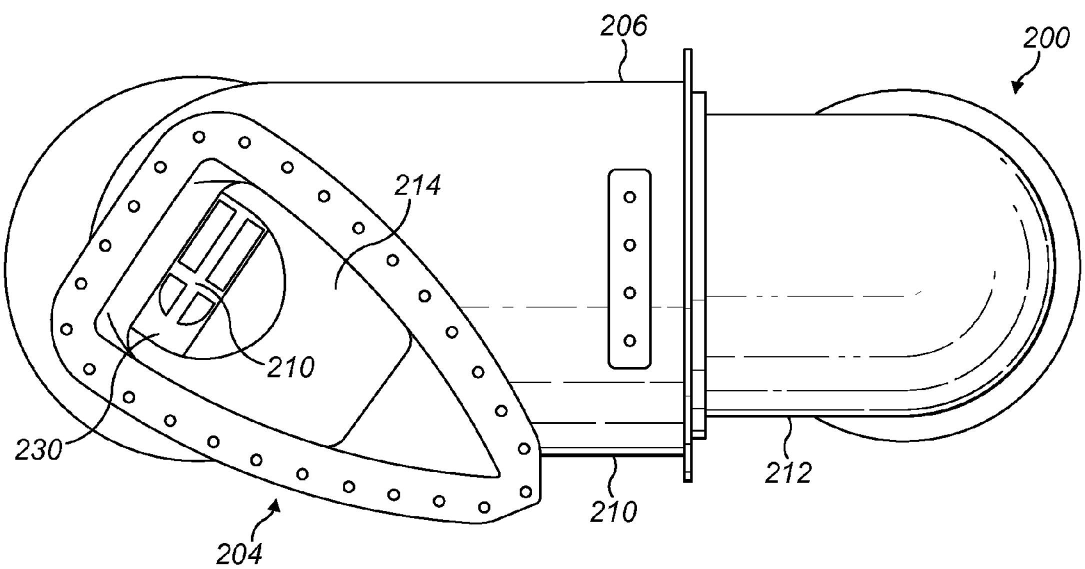

206
200
214
210
230
212
210
204

FIG. 2b

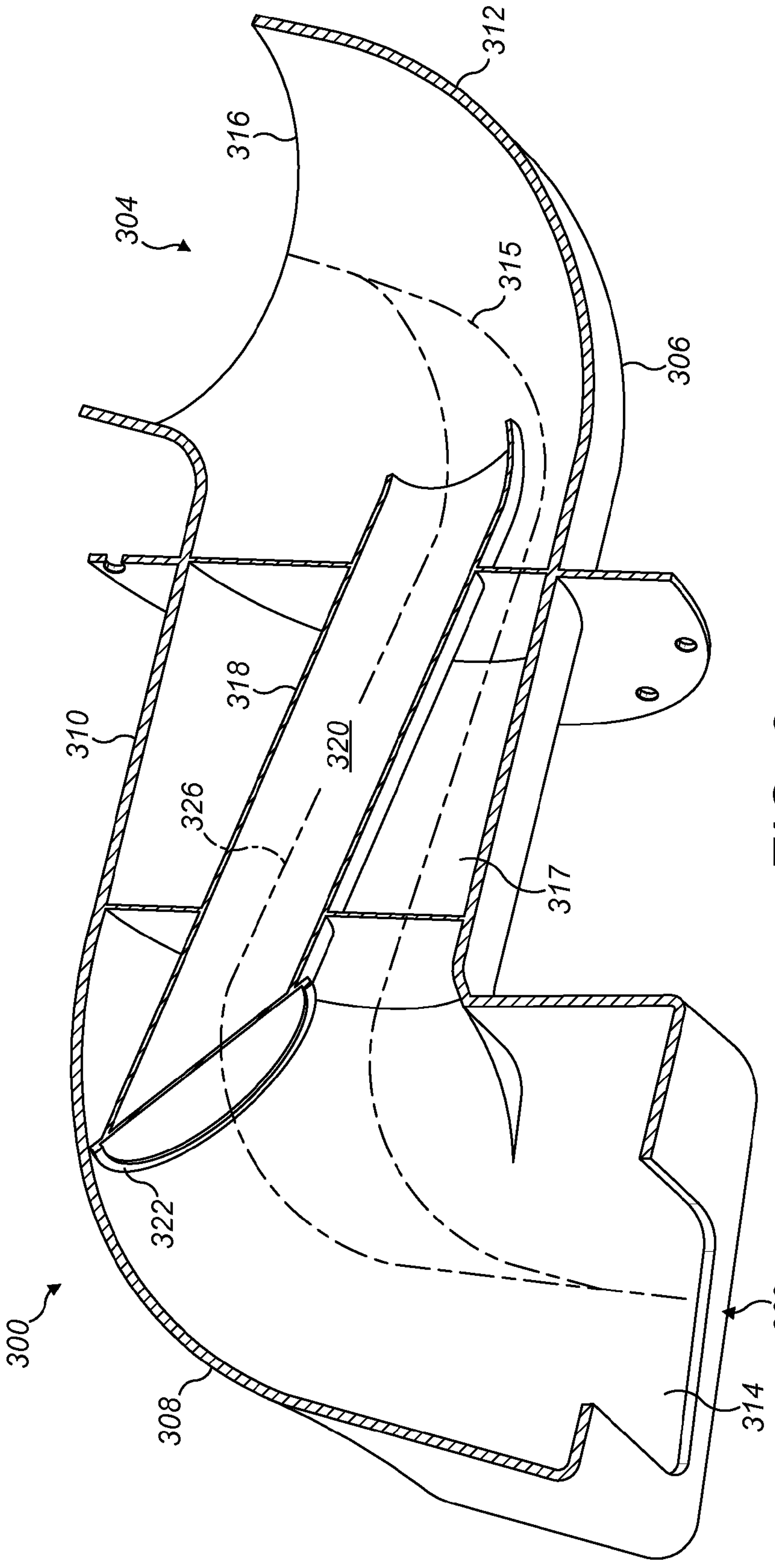


FIG. 3a

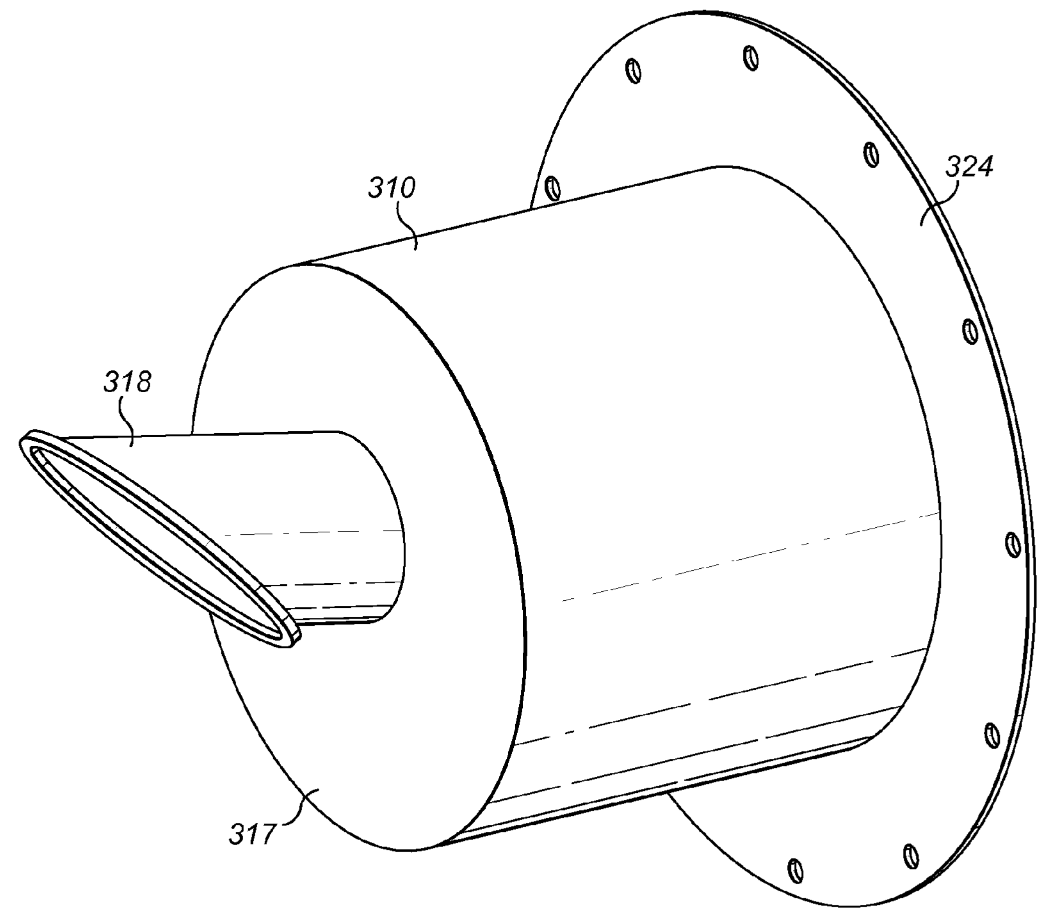


FIG. 3b

AIRCRAFT FUEL TANK VENT PROTECTOR

This application claims priority to GB 1202545.8 filed 14 Feb. 2012, the entire contents of which is hereby incorporated by reference.

BACKGROUND OF INVENTION

The present invention is concerned with an aircraft fuel tank vent. More specifically, the present invention is concerned with a combined fuel tank vent protector and overpressure device.

Aircraft fuel tanks need to be vented to the atmosphere in use. Increasing and decreasing fuel levels due to fuelling and fuel consumption respectively means there is a variable volume of the tank in and out of which air needs to be able to flow. If air were not able to flow in and out of this volume, fuel entry into, and exit from, the tank would be impeded.

Furthermore, as the aircraft's altitude changes, variations in local atmospheric pressure need to be accounted for to prevent a large, undesirable pressure differential across the skin of the fuel tanks.

Still further, there is a possibility that during fuelling of the tanks they will overflow. In this case the fuel must be able to flow freely from the tank without causing excessive pressure within the fuel tank.

In order to allow flow in and out of the tanks, vents are provided. Such vents are commonly provided with vent protector devices disposed between the vent and the tank. Vent protectors comprise a duct in communication with the tank exterior, which may comprise one or more bends. They may contain other components to ensure that only air, vapour and fuel can pass between the tank and the exterior.

Such vent protector devices may possibly, under certain rare conditions, become blocked.

In order to overcome the problem of blockage overpressure devices have been developed which form an alternative path from the tank to the atmosphere. The overpressure devices do not permit flow under normal operating conditions of the vent protector. However, when the vent protector becomes blocked, the overpressure device is activated and allows passage of fluid in or out of the tank.

In some aircraft fuel tank designs the overpressure device is designed to operate even if the vent protector is not blocked. In these designs the overpressure device will operate to prevent excessive positive or negative pressure differentials between the inside and outside of the tank. These pressures may arise due to fuel overflow during fuelling or a rapid ascent or descent during flight. In any case, the overpressure devices are arranged to prevent excessive pressure differentials from forming between the tank and the exterior.

In known systems, the vent protector and overpressure device are separate components, requiring two penetrations of the fuel tank. This is undesirable for fuel tanks positioned near flight surfaces (e.g. in the wing) because wing skin penetrations create undesirable noise effects and reduce aerodynamic efficiency.

SUMMARY OF INVENTION

It is an aim of the present invention to provide an improved fuel tank vent protector.

According to a first aspect of the invention there is provided an aircraft fuel tank vent having a first interface for fluid communication with an aircraft fuel tank interior, and a second interface for fluid communication with an aircraft fuel tank exterior, the vent comprising:

a first flow path between the first interface and the second interface, the fuel tank vent having a vent protector positioned in the first flow path, and,

a second flow path between the first interface and the second interface, the fuel tank vent having a valve positioned in the second flow path,

wherein the first and second flow paths are common along at least a part of their length such that they are coincident at the second interface.

By coincident, we mean that the flow paths could converge into a single path (i.e. able to mix), or that one flow path is contained within another, in which case the paths may not be able to mix. What is important is that the flow paths are at substantially the same position at the second (i.e. exterior) interface.

Advantageously, providing at least partially coincident flow paths provides the ability to have a single port at the exterior of the fuel tank. If the fuel tank is mounted behind a flight surface (e.g. a wing), this is advantageous as reducing the number of orifices reduces unnecessary drag on the wing and the amount of noise produced.

SUMMARY OF DRAWINGS

An aircraft fuel tank vent protector in accordance with the present invention will now be described in detail and with reference to the accompanying drawings in which:

FIG. **1***a* is a side section view of an aircraft wing comprising a first vent protector in accordance with the present invention,

FIG. **1***b* is a sectioned perspective view of the vent protector of FIG. **1***a*,

FIG. **2***a* is a sectioned perspective view of a second vent protector in accordance with the present invention,

FIG. **2***b* is a bottom view of the vent protector of FIG. **2***a*,

FIG. **3***a* is a sectioned perspective view of a third vent protector in accordance with the present invention, and,

FIG. **3***b* is a perspective view of a part of the vent protector of FIG. **3***a*.

DETAILED DESCRIPTION OF THE INVENTION

A vent protector **100** is shown in FIGS. **1***a* and **1***b*. The vent protector **100** comprises a fuel tank interface **102** and a vent interface **104**. As shown in FIG. **1***a*, the fuel tank interface **102** is in fluid communication with a fuel tank **10** within an aircraft **12**. The vent interface **104** is in fluid communication with the external atmosphere **14** via an orifice **16** in the external surface **12**.

The vent protector **100** comprises a vent duct **106** having a first elbow **108**, a straight section **110** and a second elbow **112**. The first elbow **108** defines a first port **114** which forms the vent interface **104**. The second elbow **112** defines a second port **116** which forms part of the tank interface **102**. The vent duct **106** permits the passage of fluids therethrough along a vent flow path **118** between the first port **114** and the second port **116**.

The vent protector **100** comprises a bypass duct **119** which extends from the first elbow **108** to an overpressure device **120** covering a third port **122**. The third port **122** forms part of the tank interface **102** with the second port **116**. The bypass duct **118** defines a bypass flow path **124** from the first port **114** to the third port **122**. The vent flow path **118** and the bypass flow path **124** coincide proximate the first port **114** and therefore the first interface **104**.

A baffle **126** is contained within the straight section of the vent duct **106**, midway along the vent flow path **118**.

The overpressure device **120** comprises a burst disc **128** which is arranged to open or rupture at a predetermined pressure differential across the overpressure device **120**. The burst disc is constructed from a thin, rupturable material and is configured to rupture at a predetermined pressure. The overpressure device **120** comprises a visual indicator on its underside, visible from the first port **114** so that an observer can check if the burst disc **128** has opened or ruptured. The visual indicator is in the shape of a cross or other easily recognisable pattern.

During normal operation, fluids (specifically air with fuel vapour) can flow in and out of the fuel tank along the vent flow path **118**. These fluids can flow through the baffle **126**.

Should the vent protector become blocked (e.g. at the baffle **126**) a pressure differential will build between the tank interface **102** and the vent interface **104**. When the pressure differential reaches a predetermined level, the burst disc **128** will open or rupture and the fluid will flow along the bypass flow path **124**.

By having the vent flow path **118** and the bypass flow path **124** coincident proximate the first port **114**, only a single vent interface **104** is required, which reduces the drag effects on any aircraft wing to which the device is attached. The noise is also reduced. Further, the complexity of installation is reduced because only the first port **114** needs to be attached at the first interface **104**.

Turning to FIG. **2**, a second embodiment of a vent protector **200** is shown. The vent protector **200** is similar to the vent protector **100** and common features are numbered **100** greater.

In the case of the vent protector **200**, the bypass duct **219** extends into the first elbow **208**, and all the way to the first port **214** where it terminates in a bypass port **230**. The bypass port **230** is within the first port **214** forming the vent interface **204**.

FIG. **2***b* shows the visibility of the overpressure device **220** from the exterior of the interface **204**.

It will be noted that similarly to the protector **100**, only a single orifice is required in the wing skin for the interface **204**.

Turning to FIG. **3***a*, a vent protector **300** is shown. The vent protector **300** comprises a vent interface **302** and a fuel tank interface **304**. The vent protector **300** comprises a vent duct **306** having a first elbow **308**, a straight section **310** and a second elbow **312**. The first elbow **308** defines a first port **314** which forms the vent interface **302**. The second elbow **312** defines a second port **316** which forms part of the tank interface **304**. The vent duct **306** permits the passage of fluids therethrough along a vent flow path **315** between the first port **314** and the second port **316**.

A baffle **317** is provided within the straight section **310**.

The vent protector **300** comprises a bypass duct **318** situated within the vent duct **306**. The bypass duct **318** comprises a cylindrical tube **320** having a overpressure device **322** positioned at a first end proximate to, and visible through, the first port **314**. The overpressure device **322** is configured to operate in the same way as the overpressure device **120**. The bypass duct **318** is angled with respect to a central axis of the straight portion **310** such that the ends of the duct **318** are tilted away from the first port **314** and the second port **316**. The tilt helps to prevent the accumulation of water at the over pressures device.

Turning to FIG. **3***b*, an assembly of the straight section **310** containing the baffle **317** and the bypass duct **318** is shown. The straight section **310** comprises a mounting flange **324**. By providing a subassembly, the combined vent and bypass duct can be installed in existing systems.

As shown in FIG. **3***a*, a bypass flow path **326** is established through the bypass duct **318** once the overpressure device **322** is open. As with the previous embodiments **100**, **200**, the overpressure device **322** opens or ruptures when the baffle **317** becomes blocked.

As can be seen in each of the above embodiments, the vent flow paths **118**, **218**, **315** all coincide with the bypass flow paths **124**, **224**, **326** proximate the vent interface **104** to provide the advantage of a single hole in the fuel tank wall. The flow paths **218**, **224** coincide in that the bypass flow path **224** is contained within the vent flow path **218**.

The bypass overpressure devices need not be pressure operated devices and may be electronically or manually actuated valves.

The invention claimed is:

1. An aircraft fuel tank vent having a first interface for fluid communication with an aircraft fuel tank interior, and a second interface for fluid communication with an aircraft fuel tank exterior, the vent comprising:

a first flow path between the first interface and the second interface, wherein the first interface is in fluid communication with an aircraft fuel tank and the aircraft fuel tank vent includes a vent protector positioned in the first flow path, and,

a second flow path between the first interface and the second interface, the fuel tank vent having a valve positioned in the second flow path,

wherein the first and second flow paths are common along at least a part of their length such that they are coincident at the second interface.

2. The aircraft fuel tank vent according to claim **1** comprising a vent protector duct and a bypass duct, in which the vent protector duct and the bypass duct share a common port at the second interface.

3. The aircraft fuel tank vent according to claim **1** comprising a vent protector duct and a bypass duct, in which the bypass duct is positioned within the vent protector duct at the second interface such that the second flow path is within the first flow path.

4. The aircraft fuel tank vent according to claim **2** in which the vent protector duct comprises a first port, the bypass duct comprises a second port, the first port and the second port being spaced apart and forming the first interface.

5. The aircraft fuel tank vent according to claim **2** in which the bypass duct extends substantially perpendicularly to the plane of the second interface.

6. The aircraft fuel tank vent according to claim **1** in which the bypass duct is completely contained within the vent protector duct.

7. The aircraft fuel tank vent according to claim **1** in which the valve is pressure sensitive.

8. The aircraft fuel tank vent according to claim **7** in which the valve is a burst disc.

9. The aircraft fuel tank vent according to claim **1** in which the valve comprises a component changeable from a first state when the valve is closed to a second state when the valve is open, which component is visible from the second interface.

10. The aircraft fuel tank vent according to claim **9** in which the component is an actuable valve body.

11. The aircraft fuel tank vent according to claim **9** in which the component is a pressure sensitive valve seal.

12. An aircraft fuel tank comprising:

a first interface in fluid communication with an interior chamber of the aircraft fuel tank;

a second interface in fluid communication with an exterior of the aircraft fuel tank;

a first fluid flow path between the first interface and the second interface;

a vent protector in the first flow path;

a second fluid flow path between the first interface and the second interface, and

a valve positioned in the second flow path, wherein the first and second fluid flow paths merge and are coincident at the second interface.

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